

# Dredging Research

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## DOER studies to build scientific foundation for determining Environmental Windows

by Dr. Lyndell Hales, U.S. Army Engineer Research and Development Center-WES

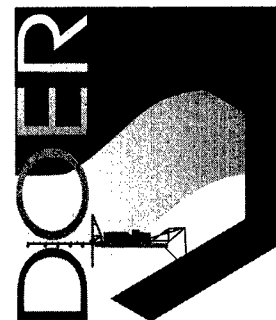
Dredging operations are routinely limited to certain times of the year to protect biological resources or their habitat. These special times are referred to as "Environmental Windows." Compliance with Windows can add to the overall cost of a dredging project as Windows are often based on subjective or inconsistent information and may be overly restrictive, according to Dr. Doug Clarke, Environmental Windows focus area manager of the Dredging Operations and Environmental Research (DOER) Program.

DOER Program research seeks to strike a balance between resource protection and cost-effective dredging operations by addressing underlying technical issues. "Rigorous investigations are ongoing in collaboration and partnership with interested resource agencies. We are working to build a knowledge base upon which to objectively evaluate the need for Windows on a project-by-project basis. Hopefully, this research will lead to effective operational measures where we can reduce or even avoid the need for Windows," said Clarke.

Dredging project managers, while aware of the need to protect biological resources, also are mandated by Congress to conduct dredging operations in as cost-effective a manner as possible. When the justification for an Environmental Window does not appear to be technically sound and the requesting agencies have not clearly articulated their underlying concerns, compli-

ance with a Window becomes controversial, especially if increased costs can be traced to the Window element. The science applied in the development of Environmental Windows often is incomplete, and timeframe decisions based on the conservative side can result in wider Environmental Windows than may actually be necessary.

Collaborative field research activities by scientists of the DOER Program during actual dredging operations in the James River near Williamsburg, VA, and in Lake Michigan at the mouth of the St. Joseph River, will demonstrate if dredging has an adverse impact on the passage of migratory fishes or on entrainment of fishes of interest by a dredge cutterhead. Prior to these planned demonstrations, pilot studies were required to be performed during authorized Environmental Windows to verify that monitoring and detection equipment and scientific capability already exist to actually determine any impact on

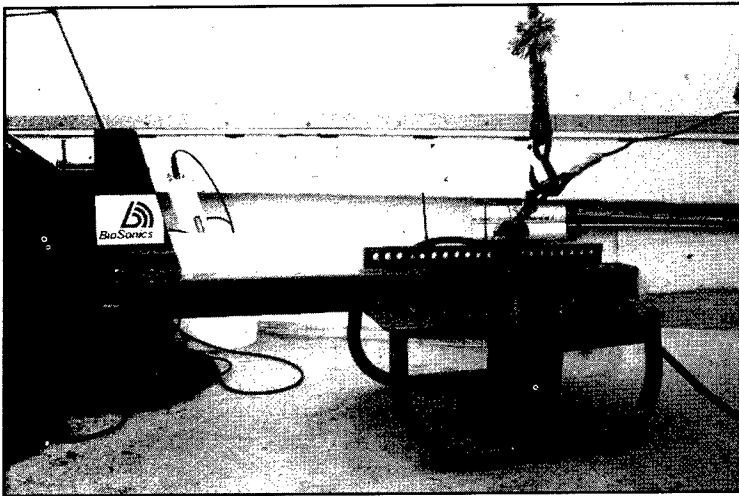


Acoustic doppler current profiler

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*Fisheries Hydro-acoustics Gear*



*Example Echogram from Fisheries Hydro-acoustics*

fish migration and/or entrainment. Results from monitoring data obtained during these pilot studies and actual demonstrations will be used in calibration of numerical models under development at ERDC-WES.

### **James River pilot study and demonstration**

A 1-week-long pilot study was conducted in the James River during October 1999 where a pipeline dredge was performing maintenance channel dredging near Williamsburg, Va. Here the main issue was the effect of dredging activities on migratory fish movement. The study was conducted within the environmental Window previously authorized for dredging activities when anadromous fishes were not present. Full cooperation by the Virginia Department of Game and Inland Fisheries and assistance by Norfolk District personnel through logistical and other support activities allowed the project to go forward. Additional assistance was provided by Virginia Commonwealth University and private consultants. The purpose of this pilot study in the Goose Hill reach of the river was to document if fishes respond to the dredge and leave the vicinity of the immediate dredging and disposal activities. Objectives of the study were:

- ↳ To characterize the spatial characteristics of suspended sediment

plumes at the dredge and at the open-water placement site.

- ↳ To determine if nonanadromous fishes respond to the presence of sediment plumes.
- ↳ To demonstrate that technically defensible data could be obtained to address those concerns used to justify the existing Window.

A combination of conventional fisheries biology techniques including gill netting was used during this pilot study, as well as new fisheries hydro-acoustic survey approaches to cover large areas of the 7,000-ft-wide river. An acoustic doppler current profiler (ADCP) also was employed to determine current profiles and flow field patterns in the region. Additionally, acoustic backscatter from the ADCP provided an indication of suspended sediment gradients and boundaries of the dredging-induced plume. The fisheries hydro-acoustic data can be superposed on ADCP data, yielding a methodology for understanding how fishes respond to water currents and suspended sediment both within and outside the area of influence of the dredge.

The pilot study, conducted when anadromous fishes were not present, documented that, indeed, nonanadromous fishes showed no response to dredging and disposal activities in a large river section where sufficient area exists for the fishes to avoid these

operations. A follow-up demonstration study planned for late March-early April 2000 will be conducted outside the previously authorized dredging Environmental Window during a period when anadromous migratory fishes (American shad, hickory shad, blue-back herring, alewives) are present. Collaborative efforts are presently under way to permit monitoring two different locations in the river. One location will be a repetition of the large open river region, and the second location will be a more confined section of the river where migratory corridors of fishes are likely to encompass suspended sediment plumes.

### **Lake Michigan pilot study and demonstration**

A study was also conducted in Lake Michigan at the mouth of the St. Joseph River within the authorized dredging Environmental Windows during summer of 1998 while maintenance dredging operations by the Detroit District were taking place. Here, the main issue was entrainment of fishes by the cutterhead during the actual dredging process. Sediment plumes generated during the dredging and disposal processes were not an issue since the shoal region which develops each winter in the lake at the entrance to the river and which must be dredged during the spring consists of sand-size particles. Spring is also the season for fish migration

including salmon which move in and out of the river. Fisheries sampling including trawl and fisheries hydro-acoustics survey techniques were employed. The hydro-acoustics data can be used to estimate the numbers of fish likely to be at risk of entrainment as a consequence of their position and depth in the water column.

In addition to salmon, other fishes of interest included alewives and spottail shiners. The area of interest included both the 200-ft-wide river outlet reach and the open lake area in the near-vicinity. This pilot study determined that technology and scientific capability exist for effectively monitoring and interpreting phenomena of interest pertaining to entrainment of fishes.

Based on results of the 1998 pilot study, the appropriate State of Michigan natural resources agencies granted permission for a full investigation to be conducted in May 1999, with dredging occurring outside of the existing Window. Analyses of the collected data are ongoing.

## Conclusions

Environmental Windows affecting dredging projects will always be an is-

sue to be resolved by negotiations with government entities and resource agencies. Presently, there are very limited negotiation tools to be used other than anecdotal information and professional judgment. Rigorous investigations conducted during actual dredging operations while fishes are present remain a critical need for provision of accurate, meaningful data upon which to base objective, reasonable Windows. Maintaining navigable waterways while protecting valuable aquatic resources can only be accomplished effectively by in-depth



*Trawl Catch*

understanding of the technical issues underlying requests for Environmental Windows.

**Additional information pertaining to these pilot studies and demonstrations and other Environmental Windows-related research topics is available from Dr. Douglas Clarke, e-mail [clarked@wes.army.mil](mailto:clarked@wes.army.mil). Information pertaining to the Environmental Windows focus area research of the DOER Program may be found on the Internet at <http://www.wes.army.mil/el/dots/doer>. About the author: Dr. Lyndell (Lynn) Hales is part of the DOER Program management team at ERDC-WES, Coastal and Hydraulics Laboratory.**

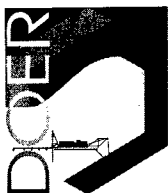
## Historical perspective of Great Lakes dredged material research reveals U.S. emphasis on region

*By Dr. Robert M. Engler, Senior Scientist (Environmental), U.S. Army Engineer Research and Development Center-WES*

Research on environmental aspects of dredged material management in the Great Lakes dates back to the 1960s with pathfinding work on aquatic bioassays and multi-agency land-based activities to decrease sediment loads. The Corps' Dredged Material Research Program (DMRP) of the 1970s emphasized research on aquatic disposal sediment bioassessment, and beneficial uses of dredged material. Research on the efficacy of the many confined disposal facilities (CDFs) were conducted in the 1980s.

The 1990s saw significant research on the treatment of contaminated sediments through the EPA's Assessment and Remediation of Contaminated Sediments (ARCS) Program.

Current dredged material research under DOER includes: (1) Contaminated Sediments activities that include manufactured soil, phytoreclamation, vegetative control, CDF surface runoff, and sediment separation processes; (2) Environmental Windows activities that include hydraulic entrainment and dredging operations on resident and migratory fishes; (3) Innovative Technologies regarding an "Eddy Pump" demonstration; and (4) Risk research to include guidance for upland disposal as well as modeling trophic transfer and risk for sediment associated contaminants (*Dr. Engler is the Executive Manager for the DOER Program*).



## Corps district personnel's 'Thinking Outside the Box' results in innovative Great Lakes projects

By David W. Bowman, U.S. Army Engineer District, Detroit

*Thinking Outside the Box* is popular jargon for going beyond traditional boundaries to develop innovative solutions to problems found in the workplace. In the Detroit District, that phrase can be taken quite literally by those involved with dredged material management.

During the 1970s and 80s, Corps activities were governed by Public Law 91-611, which allowed the Great Lakes districts to construct confined disposal facilities (CDFs) at navigation projects when the material dredged was unsuitable for in-water disposal. A CDF is a huge box where dredged material can be placed for 10 or more years. The Corps' focus has always been on ensuring confinement of the dredged material, with treatment efforts focused mainly on dewatering. Today, Great Lakes districts are dealing with the fact that most CDFs constructed under the original authority are filled to capacity. Constructing new CDFs is often not feasible because of valuable shallow-water habitat loss. In addition, ever-rising construction costs can be a factor, although now local ports must partially support such projects financially. An alternative to be considered, therefore, is the beneficial use of the dredged material.

In many instances the Corps or the ports have identified ways to use the dredged material beneficially but funding was simply not available to try these new and innovative concepts. Now, with the help of the Corps' Dredging Operations and Environmental Research (DOER) program and the EPA's Great Lakes National Program Office (GLNPO), the Detroit District is able to evaluate ways to manage the dredged material as a resource. The hope of one day converting existing CDFs from disposal facilities into treatment and recycling facilities is sparking

activities that may ultimately lead to an improved way to manage CDFs and dredged material.

The first step in the process has been to bring in partners who have a vested interest in the harbor. In January 1998 the Detroit District partnered with other stakeholders at Green Bay and Milwaukee to submit proposals to the GLNPO Grant Program. Representatives from GLNPO liked the idea of leveraging their funds not only with the Detroit District's O&M program, but also with the DOER program and state and local sponsors as well. Three projects were funded by GLNPO for more than \$400,000 total.

### Pilot study

The first project conducted was a pilot scale demonstration at the Milwaukee and Green Bay CDFs. Partners in the Topsoil Creation Project include GLNPO, the DOER program, and the local sponsors at Green Bay and Milwaukee. A team from the Detroit District and ERDC-WES is using a very old-fashioned idea to tackle the contaminated sediment problem: composting. Dredged material is mixed with organic matter (to provide nutrients and microbes) and wood chips (to provide moisture) to see if remaining contaminants in the dredged material can be degraded.



*Scat Turner in Operation on the Milwaukee CDF*

*Photo by Jeff Talley*



*Photo by Dave Bowman*

When the composting is completed, the mixture will be tested for suitability to market as a topsoil or topsoil amendment. A Visitor's Day conducted in September 1999 allowed state and federal regulators to see the composting operation at work (see *Dredging Review*, Vol. 2 No. 3, p. 7, for story).

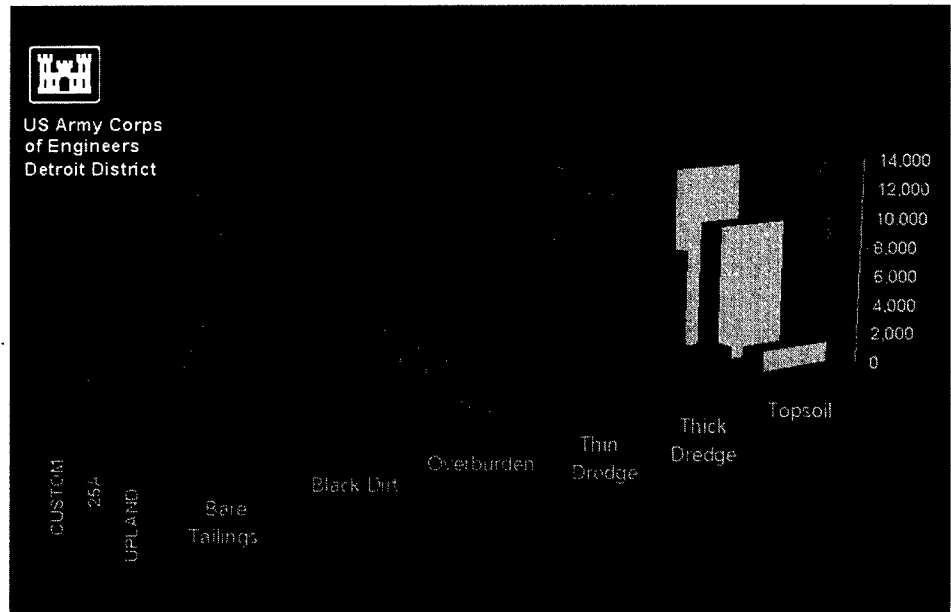
## Hydrocyclone project

Detroit District personnel are also supporting ERDC-WES and GLNPO in constructing a mobile treatment plant for handling dredged material. The project uses an innovative piece of equipment called a hydrocyclone to separate contaminated silts and clays from clean sands. The unit creates a whirlpool effect where sand drops to the bottom while silts and clays remain in suspension. The silts and clays are then pumped into the CDF. The removed sand can be used beneficially and CDF capacity is retained. A team from the Detroit District is tackling the design and construction. This summer, District project engineers will conduct a demonstration of the unit at the Bayport CDF in Green Bay.

## Strip mine reclamation

Finally, the District is supporting GLNPO and the Minnesota Department of Natural Resources (MDNR) in tackling another environmental problem: mine waste. During strip mining operations in northern Minnesota, thousands of acres of land have been stripped of topsoil to get to the valuable ore below. After the mining is completed, the soil lies barren. Topsoil to redevelop these areas is often not available.

The Corps handles tens-of-thousands of cubic yards of dredged material every year from the Duluth-Superior Harbor. For years this material has been placed in the Erie Pier CDF, which is now filled to capacity. Corps and MDNR personnel felt that dredged material, rich in nutrients and organic matter, would be ideal for creating wetlands on top of the mine waste. The



*Growth of vegetation on the dredged material as compared to the bare mine tailings, other available sources of capping material, and commercially available topsoil. Biomass Growth for Three Seed Mixtures on Substrate Plots (kg/ha). Mined Land Reclamation project. Data from Mr. Paul Eger, Minnesota Department of Natural Resources*

EVTAC Mine in Eveleth, Minn., stepped forward and offered to offload the dredged material from ore cars and transfer it to a reclamation site. The problem was how to get the dredged material from the harbor up to the mine site where it was needed. The District's planners studied the idea of using ore trains (which bring ore down to the harbor but return empty) to transfer the dredged material back to the mine.

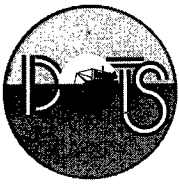
The Minnesota DNR will conduct a demonstration project this summer which will move 3,000 cubic yards of dredged material from Erie Pier to the EVTAC site over the Duluth, Missabe & Iron Range Railway. DNR will also seed the dredged material with wetland plants and Detroit District personnel will ensure regulatory compliance.

## Summary

Hopefully, these demonstration projects will allow the Detroit District to convince State and Federal Authorities to think of dredged material not as "spoil" but as a resource with many potential beneficial uses. Success of the demonstrations could lead to the removal of hundreds of thousands of cubic yards of dredged material, allowing CDFs to operate for many years.

*Thinking Outside the Box* has become a necessity in the private sector and in the Government. Many good ideas for cost savings, and a more efficient Corps of Engineers, are out there if we consider new ways of looking at old problems.

Additional information is available from Mr. David W. Bowman, [David.W.Bowman@lre02.usace.army.mil](mailto:David.W.Bowman@lre02.usace.army.mil), U.S. Army Engineer District, Detroit, or from ERDC-WES, Dr. Tommy Myers, [myerst@wes.army.mil](mailto:myerst@wes.army.mil); and Ms. Trudi Olin-Estes, [olint@wes.army.mil](mailto:olint@wes.army.mil).



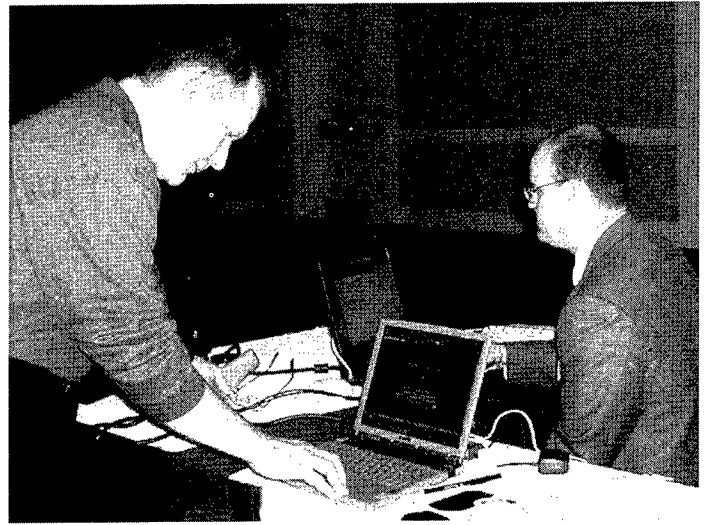
## Corps/EPA Dredged Material Management Seminar held

The annual joint U.S. Army Corps of Engineers/U.S. Environmental Protection Agency *Dredged Material Assessment and Management Seminar* was held Jan. 11-13, 2000 in San Diego, Calif.

Approximately 200 engineers and scientists from all levels of government including federal, state, and local agencies as well as private consultants attended. The seminar was directed at individuals who are assessing the risks of disposal or are developing better techniques for management of the 325-million cubic yards of material dredged from the nation's waterways and ports.

Some 5 percent of the material is contaminated and requires special handling and management. Numerous environmental laws and regulations apply to dredging and dredged material disposal activities. Congress charged the Corps and the EPA with the responsibility for developing national and regional disposal criteria. A part of this mission is to ensure that the least costly disposal alternative is considered, and that this alternative is consistent with sound engineering practices while meeting national environmental standards as well as other regulatory requirements.

Seminar participants received information about the latest technology pertaining to water and sediment sampling, testing, and analysis. Evaluation and interpretation of results for all disposal alternatives within the context of guidance criteria developed by the Corps and EPA were presented. Current Corps research that addresses increasingly stringent contaminant restrictions is conducted under the "Long-Term Effects of Dredging Operations," (LEDO), and "Dredging Operations and Environmental Research," (DOER) Programs. Researchers presented the latest findings in the



Mr. Thomas R. Patin (left) and Dr. Todd Bridges are setting up computers for a presentation that included internet access and electronically projected visuals

context of developing state-of-the-practice dredged material management alternatives.

Technologies for quantifying contaminated dredged material disposal risk and effects were presented, since ecological risk and exposure effects assessments in the evaluation of dredged material are increasingly required. Seminar participants also were instructed on design and management of confined disposal facilities for storing contaminated sediment as well as an array of beneficial uses for suitable material.

Briefing slides from this seminar are located online at <http://www.wes.army.mil/el/dots/pubs.html>.

